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PREDICTING THE ACADEMIC PERFORMANCE OF GRADUATE STUDENTS: A REVIEW

by

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A number of research efforts concerned with predicting the academic performances of graduate students are reviewed. The discussion is organized according to the types of predictors and criteria used. The results of many prediction studies are integrated using tabular presentations. Implications of the findings for making graduate student selection decisions are discussed.

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Predicting the Academic Performance of Graduate Students: A Review

John Senger
and
Richard Elster

Graduate schools everywhere are faced with the naggingly persistant responsibility of selecting from a list of applicants those most likely to perform successfully in their programs. The process by which students are selected has developed into a modest science falling somewhere between running a longshoreman's morning line-up and the choosing of astronauts.

The problem has generated a literature which is reviewed here to determine what predictors and what criteria are used for graduate student selection and to evaluate the relative success of the predictors used. The bulk of the research involves correlation analysis, and it is hoped that the tabular presentation of these data will provide the reader a holistic impression of the varied findings.

The article is organized into the following five segments: The Criterion Problem, Kinds of Predictors, Aptitude Variables as Predictors, Environmental Variables as Predictors, and Personality Variables as Predictors.

The Criterion Problem

The most frequently used criterion is graduate grade point average (GGPA), probably because it is an easy one to use. Systems exist for grading student performances, gathering these data, and reducing them to one simple statistic--the grade average. There have been sufficient questions about grading systems and the concept of grades generally (cf. Newsweek, and Payne, 1968) to cast some doubt on this criterion however. When college grades themselves are cast in the role of a predictor their performance has been mediocre to poor (cf. Hoyt, 1965). In

some cases criteria similar to grade point average are used, e.g., achievement examination scores or proportions of "A" grades. Other criteria for graduate student performance include: (1) success or failure in completing an academic program, e.g., M.S. or Ph.D. (see references in Table III); (2) faculty ratings of students other than by grades (cf. Hilton, Kendall, and Sprecher, 1970); and (3) self ratings (cf. Hackman, et al., 1970). However, the criterion most often encountered in the literature was the grade average.

Kinds of Predictors

Measures of academic aptitude are some of the most often used predictors. These include the Graduate Record Examination Aptitude test which measures quantitative (GRE-Q) and verbal (GRE-V) aptitude. The Graduate Record Examination Advanced (GRE-A) tests examine knowledge in various academic disciplines. The literature reveals The Miller Analogy Test (MAT) to be popular among psychology departments and schools of education. This paper will concentrate on these test measures (GRE-V, GRE-Q, GRE-A, and MAT) and undergraduate grade point average (UGPA), because their popularity makes possible a comparative analysis. UGPA may be said to represent an intelligence measure, but as a sample of past performance it also undoubtedly reflects motivational and other individual differences (Tyler, 1965, p. 108ff.).

Other predictors we encountered in our review are myriad. Here are some:

The number of courses taken in a specific discipline.

The grades in specific courses.

Written statements by the candidate.

Lettersof recommendation.

Personal interviews.

Biographical data (from birth order to age, to amount of laboratory experience, etc.)

Quality of undergraduate institution.

Environments of undergraduate institutions.

Personality and interest measures.

Measures of motivation.

We see here most of the sorts of predictors used in any selection process. The predictors reported in the open literature are predominantly individual intelligence measures. The results obtained using such measures will be presented in the next section of this paper.

Aptitude Variables as Predictors

By far the most popular method of analyzing the relationship between predictors and criteria is via correlational statistics, e.g., product-moment, bi-serial, and point bi-serial.

Tables I, II, and III summarize data from 31 analyses made during the past decade. The coefficients are presented without referring to their statistical significance. The reader should also be aware of the fact that not all of these correlations represent the results of crossvalidation efforts.

The studies in the literature using multiple regression analysis are not reviewed here because the varying mix of predictors make the findings difficult to compare. Generally speaking, the inclusion of several pertinent variables in a multiple regression analysis can, of course, improve the correlation. Other studies using non-comparable analytical techniques e.g., discriminant function analysis, have not been included. Table I presents data from studies utilizing either graduate grade point average or achievement examination scores as the criterion. Table II shows studies using faculty ratings of students as criteria and in Table III completion of degree requirements is the criterion. All three tables present Graduate Record Examination--Verbal, Graduate Record

TABLE 1

Summary of Correlations

Between Selected Predictors and Measures of Graduate Academic Performance

Institution	Course of Study	Level of Study	N	Predictors						References[8]	Publication Date
				GRE-V[2]	GRE-Q[3]	GRE-T[4]	GRE-A[5]	MAT[6]	UGPA[7]		
Univ. of Florida	grad.	grad.	20[b]	.21[b]	.24[b]	.21[b]		.57[b]	-.08[b]	Robertson & Hall	1964
			18[b]	.14[b]	.38[b]	.39[b]		.39[b]	.02[b]		
Boston College	all	all	569	.19	.18					Madaus and Walsh	1965
Minnesota	Educ.	grad.	75					.34[a]		Bentley	1966
Syracuse	Educ.	grad.	219					.26		Payne & Tuttle	1966
								.51[b]			
Univ. of Virginia	Arts & Sc.			.13	.10				.21	Off. of Inst. Anal. U. of Va.	1966
Univ. of Illinois	Chem.		155	.16	.35					Duff, in Lannholm (1972)	1966
	Physics		124	.21	.38						
	Math		143	.21	.16						
	Psych		55	.20	.38						
	History		33	.39	.28						
	English		81	.48	.13						
	Soc. Wrk.		80	.48	.38						
	Music		90	.65	.43						
Nav. Postgrad Schl.	Mgt.	MS	100	.51	.73					Jantz and Austin	1966
Nav. Postgrad Schl.	Mgt.	MS	78	.44	.70					Golanka & Gilmore	1967
Adelphi U.	Psych	Doc.	37	.20	.26		.35	.47		Stricker & Haber	1967
No. Illinois U.	Educ.	MS		.37	.32					Clark	1968

[1]Unless otherwise noted the performance measure is graduate grade point average. [2]Graduate Record Examination-Verbal
[3]Graduate Record Examination-Quantitative. [4]Graduate Record Examination (Verbal score plus Quantitative Score).
[5]Graduate Record Examination-Advanced. (Where applicable, area is indicated in "Course of Study" column).
[6]Miller Analogies Test. [7]Grade Point Average in undergraduate institution. [8]See Reference List for complete reference.

Between Selected Predictors and Measures of Graduate Academic Performance (Table 1 Cont)

Institution	Course of Study	Level of Study	N	Predictors: GRE-V[2]	GRE-Q[3]	GRE-T[4]	GRE-A[5]	MAT[6]	UGPA[7]	References[8]	Publication Date
Washington State	Psych.	grad.	66	.08	.21	.18	.09			Newman	1968
NYU	Educ.	grad.	31	-.01[e]	.17[e]		.44[e]	-.28[e]	.11[e]	Ewen	1969
Colorado State	Educ.	Doc.	231	.32	.21		.28			Roscoe & Houston	1969
Nav. Postgrad. Schl.	Mgt.	MS	142	.43	.65					Senger, Wyatt & Knapp	1969
Sacramento State	Educ.	MS		.33	.15		.38			Test Officer Sacramento State	1969
UCLA	Psych	grad.	266	.17[c]	.27[c]				.10[c]	Mehranian	1969
				.12[d]	.48[d]				.08[d]	Roscoe & Houston	1969
Colorado State U.	Various	Doc.	231	.32	.21					Hackman, Wiggins & Bass	1970
Univ. of Illinois	Psych	Doc.	63							Williams, et. al	1970
U. of North Dakota	Educ.	Doc.	33	-.01	-.01		.08	.03	.14	Jackson, in Lannholm (1972)	1970
U. of Wisconsin	Educ.		58	.23	.31					Roberts, in Lannholm (1972)	1970
Wake Forest U.	Biology		41	.24	.27		.36				
	Chem.		31	.55	-.07		.11				
	Educ.		27	.43	.27						
	Eng.		60	.17	.01		.64				
	Hist.		63	-.31	-.18		.31				
	Math		37	.41	.55		.47				
	P.E.		12	.16	.32						
	Physics		27	-.50	-.01		.30				
	Psych		42	.07	.23		.18				
	Relig.		17	.05	.05						
	Soc.		24	.16	.17		.89				
	Speech		5	.32	.15		-.82				

[c]Psychology course grades [d]Statistics grades [e]percentage of "A" grades

Summary of Correlations

Between Selected Predictors and Measures of Graduate Academic Performance (Table I Cont.)

Institution	Course of Study	Level of Study	N	Predictors						References [8]	Publication Date
				GRE-V[2]	GRE-Q[3]	GRE-T[4]	GRE-A[5]	MAT[6]	UGPA[7]		
Tennessee Tech. U.	Educ.	MS	241					.40	.49	Ayers	1971
USC	Educ.	Doc.	844	.42	.27					Michael, et. al	1971
Eastern Mich. U.	Physics	MS	25	.58[d]	.21[d]					O'Dell	1973
			20	.27[d]	.23[d]						

TABLE II

Summary of Correlations

Between Selected Predictors and Faculty Rating of Graduate Students

Institution	Course of Study	Level of Study	N	GRE-V[1]	GRE-Q[2]	GRE-T[3]	GRE-A[4]	MAT[5]	UGPA[6]	Reference[7]	Date
Univ. of Florida	Psych	Doc.	50	.22	.18			.19	.20	Robertson & Hall	1964
UCLA	Psych	grad.	352	.15[a]	.10[a]		.31[a]	.14[a]	.24[a]	Mehrabian	1970
				.12[b]	.12[b]		.40[b]	.12[b]	.39[b]		
Illinois	Psych	Doc.	42	.29	.29		.08		-.08	Hackman et. al	1970
Univ. of Oregon	Psych	Doc.	86			.11				Dawes	1971
			96				.21				
Univ. of Kansas	Psych	grad.		.11	.27		.23	.26	.37	Shaffer & Rosenfeld	1968

[1]Graduate Record Examination-Verbal

[2]Graduate Record Examination-Quantitative

[3]Graduate Record Examination-Total (Verbal score plus Quantitative score)

[4]Graduate Record Examination-Advance (where applicable, area indicated in course of study column)

[5]Miller Analogies Test

[6]Undergraduate Grade Point Average

[7]See Reference List for complete reference.

[a]Correlation with estimate of research potential

[b]Correlation with estimated mastery of course content

TABLE III

Summary of Correlations

Between Selected Predictors and Completion of Degree Requirements

Institution	Course of Study	Level of Study	N	GRE-V[1]	GRE-Q[2]	Gre-A[3]	MAT[4]	UGPA[5]	Reference[6]	Date
North Dakota	Educ.	Doc.	84	.08	.34	.34	.10	.36	Williams, Harlow & Gab	1970
NSF Fellows	Biology Male	Doc.	320	.20	.21	.18			Creager	1965
	Biology Fem.	Doc.	140	.06	.11	.17				
	Chem. Male	Doc.	500	.12	.21	.31				
	Chem. Fem.	Doc.	160	.17	.27	.37				
	Eng. Male	Doc.	300	.28	.21	.31				
	Geo. Male	Doc.	119	.30	.27	.20				
	Math Male	Doc.	250	.22	.26	.34				
	Phys. Male	Doc.	600	.15	.26	.32				
	Psych. All	Doc.	99	.13	.13	.25				
NYU	Psych.	Grad.	31	.17	.22	.66	-.07	.10	Ewen	1969
U. of Georgia	Ed.	Master	217	.29	.29				Payne, Wells & Clark	1971
	Ed.	Master	53				.06			
			458					.31		
	Ed.	6 yr. cert	33	.29	.26					
			100					.14		
		Doc.	51	.14	.18					
			15			.29				

[1]Graduate Record Examination-Verbal [2]Graduate Record Examination-Quantitative

[3]Graduate Record Examination-Total (Verbal score plus Quantitative score)

[4]Graduate Record Examination-Advanced (where applicable, area indicated in "course of study" column).

[5]Undergraduate Grade Point Average [6]See reference list for complete reference.

Examination-Quantitative, Graduate Record Examination-Advanced, the Millers Analogy Test, and Undergraduate Grade Point Average as predictors. Studies in academic areas such as psychology and education seem to have a disproportionately heavy representation in Tables I-III, due, no doubt, to the popularity of this sort of research in these disciplines. A huge proportion of the coefficients presented on the tables represent statistically significant relationships, however, it is not statistical significance, but, predictive significance that we wish to emphasize in this review. Individuals participating in the selection of students for graduate study, will, of course, want also to consider the magnitudes of the correlation coefficients in the context of their departments' selection ratios and current baserates of student success. These factors play a major role in determining whether or not a correlation between a criterion and a predictor set is "large enough" (Taylor and Russell, and Abrahams, Alf and Wolfe).

Choosing, albeit arbitrarily, a correlation coefficient value of .35 as indicating marginal predictive respectability we find in Table I that less than half of the 42 GRE-V coefficients equal or exceed that value. A higher standard, .50, yields only three correlations. The GRE-Q is even less inspiring. Thirteen of the forty-one coefficients exceed .35, and four are above .50. The same results exist for the GRE-Advanced data; slightly more than half the correlations exceed .35 and two are higher than .50. MAT results are at least as bleak, five of the six coefficients presented are below .35.

In what appears to have been an exhaustive review of studies using the GREs, Willingham summarizes the predictive track records of the GREs, UGPA, and letters of recommendation. The validities of these measures in predicting criteria such as GGPA and overall faculty ratings are presented (via median validity coefficients)

as are their median validity coefficients in each of nine fields of graduate study. These median validity coefficients are nearly always less than .40, and have a typical value of around .30.

One might argue that aptitude measures should not be particularly good predictors of scholastic productivity, because student motivation may be such an important factor. Undergraduate grade average should reflect both intelligence and motivation and should, therefore, be a better predictor of graduate performance than aptitude measures alone. Right? Wrong! Table I shows only one study in which the correlation between GGPA and UGPA was above .35. None exceeded .50.

These results do not produce great confidence in what one might otherwise believe to be useful predictors. Perhaps it is the criterion, graduate grades, that is responsible for the relatively low correlations. Tables II and III present alternative criteria - but with the same kind of indifferent results. Using completion of degree requirements as the standard, we find the correlations to be positive, but again at a very modest level. Of the 37 correlations with GRE-V, GRE-Q, GRE-A, MAT, and UGPA, only one exceeds .50, and it's the same one that exceeds .35.

When we look at the faculty evaluation criterion, only two (GRE-A and UGPA) of the 19 coefficients exceed .35, and none are over .50. Why do these predictors perform so modestly?

Somewhat higher validity coefficients were found in studies carried out at the Naval Postgraduate School in 1966 and 1967. Here we find correlations between grades and GRE-V of .51, .44, and .43, and GRE-Q correlations are even higher, .73, .70, and .65. These higher correlations may be caused by such factors as adequate financial support of the students during their studies. They may also reflect a homogeneous level of motivation for older more career ensconced students. Another plausible explanation is statistical.

In nearly all the studies reported here, with the exception of the Naval Postgraduate School studies, the predictor data were used to select students for the graduate programs. Truncated samples undoubtedly resulted, with only the higher ends of the predictor distributions being represented. This being the case, the correlations would be lower than they would have been without the restriction of range on the predictors, (Thorndike, 1949, p. 170).

Of course, the intellectual factors represented in this section are not the only ones which affect student performance. The low correlations may reflect the influence of variables other than intelligence. In the Predictors section several such factors were listed. An important amount of research has been performed in two of them, the college environment and individual personality. Though the major part of this research has focused on undergraduates, the findings might well be extrapolated to graduate level performance prediction. A discussion of some of these studies is included in the following two sections.

Environmental Variables as Predictors

Most of the research into college environment and institutional quality revolves around Astin's examination of the subject during the 1960's. Astin and Holland developed an Environmental Assessment Technique. This includes three sets of variables: (1) the six Holland (Holland, 1959) vocational classifications (Realistic, Intellectual, Social, Conventional, Enterprising and Artistic), (2) the size of the institution, and (3) the intelligence level of the student body. This latter an estimate derived from a sample of undergraduates entering 335 institutions. The estimate was based on their National Merit Scholarship scores (Astin and Holland, 1969, p. 308). Astin found the environmental variables Intellectual, Enterprising and Artistic to correlate positively

with student body intelligence level. The Realistic, Social and Conventional orientations correlated negatively. Astin found that the aspiration of talented students to obtain a Ph.D. was negatively affected by the size of the student body and the Conventional orientation (Astin, 1963). Institutions scoring high on these factors tended to emphasize sports and social activities at the expense of scholarship. He also found that student faculty relations were less effective and improvement in study habits was inhibited. In another study, Astin found that student achievement as measured by GRE advanced tests in the areas of social science, natural science and humanities, correlated poorly with traditional indices of institutional quality such as intellectual level of classmates, competitiveness or institutional affluence (Astin 1968). Institutions characterized by intelligent students, competitiveness and affluence do turn out students that perform better on a variety of accomplishment measures. This difference disappears, however, when a correction for individual differences in student ability is made. Freshman grade point averages were higher for students in the more selective schools, but when selectivity was taken into account, such factors as size, wealth, location, type of control (e.g., state, private, religious) and curriculum appeared to make little difference in student performance (Astin, 1971, p. 27).

Hood and Swanson (1965) using somewhat different methods characterized colleges in the state of Minnesota as agriculture, institute of technology, college of liberal arts (all in the University of Minnesota), private liberal arts, Catholic male, Catholic female, state and junior. They were able to state that a student falling at the 50th percentile in the Minnesota Scholastic Aptitude Test would probably be expected to fail at the University Institute of Technology or College of Liberal Arts with a 1.4 or 1.6 (out of 4.0) average,

be placed on probation with a 1.9 at a typical private liberal arts college or Catholic men's college, and to make a C+ average at a Catholic women's college a junior college, or a state college.

Hackman, Wiggins and Bass (1970) found that the "quality" of the undergraduate institution, as assessed by members of the University of Illinois Psychology Department faculty, correlated .30 with the student's own assessment of his progress toward a Ph.D., .31 with faculty judgment and .43 with his relative "success"[1] six years out of school.

It appears the conventional wisdom is correct: a B+ average at one institution may not reflect the same level of educational accomplishment as does a B+ average at another institution. Typically, a student could expect to obtain higher grades in a less selective college than he could in a more selective one, as grade distributions at an institution tend to float with the relative abilities of the students in attendance (Hoyt and Munday, 1966).

There is some indication that newer environmental assessment techniques which identify a school's "personality" may provide insight into the performances of its graduates in advanced degree programs. In summary, it would seem that use of a measure of undergraduate institutions selectivity, like Astin's seven point scale (Astin, 1971, p. 48), should help improve predictions of graduate study performance.

Personality Variables as Predictors

Personality factors would seem to account for some of the variance unexplained by academic aptitude measures and undergraduate grades. One variable would be the need for achievement. Projective testing of this motivation orientation has been carried out at Harvard by McClelland and his colleagues. Early results were spotty, varying between moderate positive to negative correlations between Themantic

[1] "Success" ranged from failure to complete the doctorate to appointment to a position in a "highly prestigious" institution.

Apperception Test (TAT) need achievement scores and college grades (McClelland, Atkinson, Clark and Lowell, 1953). Personality inventory measurements of achievement motivation have fared little better. A study by Gough and Hall (1964) found no significant correlations between the two achievement scales on the California Personality Inventory and medical school GPA, but significant correlations were found for Sociability (.35) Tolerance (.34) and Intellectual efficiency (.40). In an unpublished study at the Naval Postgraduate School, Senger, Wyatt, and Knapp found a statistically significant correlation (.26) between CPI Achievement via Independence and also Intellectual Efficiency (.25) Psychological Mindedness (.24) and Flexibility (.17).

The Achievement scale on the Edwards Personal Preference Schedule (EPPS) is another popular measure of this motivation, but, as in the case of the CPI, the literature relating it to academic performance seems surprisingly thin. At Carnegie Institute of Technology, Krug (1959) found significantly higher scores on the Achievement scale among academic over-achievers as compared to under-achievers. Gabhart and Hoyt (1958) found similar results at Kansas State. Both studies found the Need for Order discriminated between under and over achievers. At the Naval Postgraduate School an unpublished study by Golanka and Gilmore (1967) found under-achievers scoring significantly higher than over-achievers on Achievement and Order. Senger, Wyatt and Knapp (1969) found, in another study at the Naval Postgraduate School, a significant positive correlation (.23) between EPPS Achievement and graduate grade point average. In sum, the situation still seems as described in 1949 (Donahue, Coombs, and Travers): motivational measures and grades tend to be only slightly inter-related.

Studies relating Strong Vocational Interest Blank (SVIB) to academic performance are examples of attempts to relate scholarship to personal interests.

Hauntras, Lee and Hebahlran (1973) found the SVIB Academic Achievement (AACH) scale to correlate .37 with grades for 423 freshman. Johnson (1969) found correlations between AACH and GPA to be .17 for arts and science students and .02 for business administration students. In the original validation studies, Campbell and Johansson (1966) found a correlation of .36 between AACH and GPA for their freshmen cross validation group. Lindsay and Althouse (1969) found an AACH-GPA correlation of .10 for male freshmen and of .25 for women. A .35 correlation between AACH and GPA was found by Wagman (1971) for an undergraduate and graduate sample.

Scores on the SVIB occupational scales are predictive of students' tendencies to stick with a curriculum, but usually are not predictive of grades (Kellogg, 1968). The lack of a correlation between SVIB scores and grades may be another example of the impact of restriction of range i.e., self selection may have yield groups having homogeneous SVIB occupational scale scores.

Summary and Conclusions

Examination of the accompanying tables of correlations between intellectual and other measures and criteria of graduate student performance does not encourage one to increase his faith in the validity of the popular predictors. It must be stated, however, that the relationships are positive, and when we take into account that most are based upon truncated samples not including low scorers, validities of these measures may be better than the typical study makes them appear.

The phenomenon of low predictor - criterion relationships may not be restricted to academic performance. Ghiselli (1966) did not find very high coefficients (almost always less than +.30 with performance criteria) in his survey of the validity of occupational aptitude tests. Difficulties in predicting performance appear to be universal. It should be noted again that the studies

reviewed here were often of concurrent, rather than predictive, validity design. The correlations are, therefore, probably smaller than they would have been without restriction of range. It should be further cautioned that the tables include samples which have not been cross-validated, probably exaggerating the strengths of the relationships presented.

Can measures of non-intellectual factors be used to improve predictions? It appears that the "quality" of the undergraduate institution may be useful in predicting graduate student performance. The underlying factor here may be the selectivity of the college, in any case this "environmental" input may be useful in interpreting the meaningfulness of the undergraduate grade point average.

It would seem that standard measures of motivation and interest should be worthwhile supplemental predictors; unfortunately studies to date do not support this expectation. Investigations using the TAT, CPI and EPPS do not provide much data which would give one confidence in finding a useful measure of motivation. The investigations using these instruments show their predictive power is usually low. The SVIB offers little more; the few studies show neither the occupational scales nor the Academic Achievement scale offering strong relationships with academic performance. Perhaps Tyler (1965, p. 119) provided an explanation when she wrote:

> A conclusion suggested by this research and compatible with all the previous work in this and other settings is that the differences in motivation leading to differences in school achievement are not those that personality theorists, with their background in the clinic and the hospital, tend to think of first. They are not differences in basic drives but in learned habits of work. They are not differences in the degree to which negative qualities like anxiety and neurotic traits are present but rather the degree to which strong and well organized positive qualities such as interests, commitment, or enthusiasm about some line of endeavor characterize an individual.

The necessity to choose from among the applicants to graduate schools persists, however, and though the relationships between predictors and criteria are not particularly strong, they can be useful for decision making... if selection ratios are sufficiently small and prior base rates of success are auspicious. (Meehl and Rosen, 1955). Dawes (1971, p. 180) stated that top graduate departments were considering as many as 100 applicants for every graduate student selected for admission. With such a selection ratio, even predictors with low validities can be expected to be useful, (Taylor and Russell, 1939, and Abrahams, Alf, and Wolfe, 1971), in decision-making. So, from, a decision-making point of view, the predictors of graduate school performance may be, in the current marketplace, good enough.

Finally, the reader should be reminded that studies using multiple predictors simultaneously were not reviewed in this paper. Such studies, usually using multiple regression, often yield higher validity coefficients than are found when using a single predictor.

BIBLIOGRAPHY

Abrahams, N. M., Alf, E. W., and Wolfe, J. H., "Taylor-Russell Tables for Dochotomous Criterion Variables," Journal of Applied Psychology, 1971, Vol. 55, No. 5, pp. 449-457.

Astin, A. W., "Further Validation of Environmental Assessment Technique," Journal of Educational Psychology, 1963, vol. 54, pp. 217-226.

Astin, A. W., The College Environment, American Council of Education, Washington, D. C., 1968.

Astin, A. W., "Predicting Academic Performance in College: Selectivity Data for 2300 American Colleges," Free Press, 1971.

Astin, A. W. and Holland, John L., "The Environmental Assessment Technique: A Way to Measure College Environments," Journal of Educational Psychology, 1961, vol. 52, pp. 308-316.

Ayers, Jerry B., "Predicting Quality Point Averages in Master's Degree Programs in Education," Educational and Psychological Measurements, 1971, vol. 31, pp. 491-495.

Bentley, Joseph C., "Creativity and Academic Achievement," Journal of Educational Research, 1966, vol. 59, pp. 269-272.

Campbell, D. P., and Johansson, C. B., "Academic Interest, Scholastic Achievement and Eventual Occupation," Journal of Counseling Psychology, Vol. 13, 1966, pp. 416-424.

Clark, Henry, Graduate Record Examination Correlation with Grade-Point Averages in the Department of Education at Northern Illinois University 1962-1966. Unpublished Master's thesis, Northern Illinois University, 1968 IN: Lannholm, Gerald V., "Summaries of GRE Validity Studies 1966-1970," Graduate Record Examination Special Report No. 72-1, 1972.

Creager, John A., "Predicting Doctorate Attainment with GRE and Other Variables," Technical Report No. 25, Washington, D. C., National Academy of Sciences--National Research Council, November, 1965.

Dawes, Robyn M., "A Case Study of Graduate Admissions: Application of Three Principles of Human Decision Making," American Psychologist, vol. 26, 1971, pp. 180-188.

Donahue, W., Coombs, C., and Travers R., The Measurement of Student Adjustment and Achievement, Ann Arbor, U. of Michigan, Press, 1949.

Gebhart, Gary G. and Hoyt, Donald P., "Personality Needs of Under-and Over-achieving Freshmen,"Journal of Applied Psychology, 1958, vol. 42, pp. 125-128.

Ghiselli, E., The Validity of Occupational Aptitude Tests, New York: Wiley, 1966

Golanka, Stanley R. and Gilmore, James G., "An Investigation of the Relationship Between the Variables of the Edwards Personal Preference Schedule and Predicted Over- and Under-Achieving Students in the Management Curriculum at the Naval Postgraduate School," Unpublished study, Naval Postgraduate School, Monterey, CA. 1967.

Gough, H. G., and Hall, W. B., "Prediction of Performance in Medical School From the California Psychological Inventory," Journal of Applied Psychology, 1964, vol. 48, pp. 218-226.

Hackman, J. Richard, Wiggins, Nancy, and Bass, Alan R., "Prediction of Longterm Success in Doctoral Work in Psychology," Educational and Psychological Measurement, 1970, vol. 30, pp. 365-374.

Hauntras, Peter T. and Lee, David L. and Hebahl, Beulah M., "Relationship Between SVIB Non-Occupational Scales and Achievement for Six Holland Personality types," Journal of Vocational Behavior, 1973, vol. 3, pp. 195-208.

Holland, J. L., "A Theory of Vocational Choice," Journal of Counseling Psychology, 1959, vol. 6, pp. 35-45.

Hood, Albert B. and Swanson, Edward O., "A Look at Student Achievement in Different Types of Colleges," Personnel and Guidance Journal, November 1965.

Hoyt, D. P., The Relationship Between College Grades and Adult Achievement: A Review of the Literature. American College Testing Program, Research Report #8, 1965, Iowa City, Iowa.

Hoyt, D. P. and Munday, L., "Academic Description and Prediction in Junior Colleges, ACT Research Report, 1966, No. 10.

Jantz, Jack L. and Austin, Jack B., "Confirmation of the Validity of Graduate Record Examination Test Scores as Predictors of Academic Performance in the Management Curriculum and the Quest for an Optimum Predictor," Unpublished Study, Naval Postgraduate School, Monterey, CA 1966.

Johnson, Richard W., "Effectiveness of SVIB Academic Interest Scales in Predicting College Achievement," Journal of Applied Psychology, vol. 53, 1969, pp. 309-16.

Kellogg, Richard L. "The Strong Vocational Interest Blank as a Differential Predictor of Engineering Grades," Educational and Psychological Measurement vol. 28, pp. 1213-17.

Krug, Robert E. "Over-and Under-Achievement and the Edwards Personal Preference Schedule," Journal of Applied Psychology, 1959, vol. 43, pp. 133-136.

Lindsay, Carl A. and Althouse, Richard, "Comparative Validities and SVIB Academic Achievement and College Student Questionnaire Motivation for Grades Scale," Educational and Psychological Measurement, vol. 29, 1969, pp. 489-93.

Madaus, George F. and Walsh, John J., "Departmental Differentials in the Predictive Validity of the Graduate Record Examination Aptitude Tests," Educational and Psychological Measurement, 1965, vol. 25, pp. 1105-1110.

McClelland, David, Atkinson, John W., Clark, Russell A., and Lowell, Edgar L., The Achievement Motive, New York, Appleton-Century-Crofts, Inc., 1953 pp. 237-242.

Meehl, P. E. and Rosen, A. "Antecedent Probability and the Efficiency of Psychometric Signs, Patterns, or Cutting Scores," Psych. Bulletin,1955, 52, 194-216.

Mehrabian, Albert, "Undergraduate Ability Factors in Relationship to Graduate Performance," Educational and Psychological Measurement, 1969, vol. 29, pp. 409-419.

Michael, William B., Jones, Robert A., Al-Amir, Hadhail, Pallias, Calvin M., Jackson, Michel, and Goo, Valerie, "Correlates of a Pass - Fail Decision for Admission to Candidacy in a Doctoral Program in Education," Educational and Psychological Measurement, 1971, vol. 31, pp. 965-968.

Newman, Richard I., "Graduate Record Examination Scores as Predictors of Grade Point Averages for Psychology Students," Educational and Psychological Measurement, 1968, vol. 28, pp. 433-436.

Newsweek, "Grade Inflation," July 1, 1974, pp. 49-50.

O'Dell, Jerry W., "The EPSAT as a Predictor," Journal of Psychology, 1973, vol. 85, pp. 165-167.

Office of Institutional Analysis, Correlations Between Admissions Criteria and University of Virginia Grade-Point Averages, Graduate School of Arts and Sciences, Fall 1964, Office of Institutional Analysis, University of Virginia, mimiographed, circa 1966, in Lannholm, Gerald V., "Summaries of GRE Validity Motivation," Journal of Applied Psychology, 1969, vol. 53, pp. 383-387.

Payne, D. A., The Specification and Measurement of Learning Outcomes, Blaisdell Publishing Co., Waltham, MA. 1968.

Payne, David A. and Tuttle, Cynthia E. "The Predictive Relationship of MAT to Objective and Subjective Criteria of Success in Graduate School of Education," Educational and Psychological Measurement, 1966, vol. 26, pp. 427-430.

Payne, David A., Wells, Robert A., and Clark, Robert R. "Another Contribution of Estimating Success in Graduate School; A search for Sex Differences in Comparison Between Three Degree Types," Educational and Psychological Measurements, 1971, vol. 31, pp. 497-503.

Robertson, Malcolm and Hall, Everett, "Predicting Success in Graduate Study," Journal of General Psychology, 1964, vol. 71, pp. 359-365.

Roscoe, John T. and Houston, Samuel R., "The Predictive Validity of GRE Scores for a Doctoral Program in Education," Educational and Psychological Measurement 1969, vol. 29, pp. 507-509.

Senger, John D. Wyatt, John M. and Knapp, Emmett J., "The Relationship Between Military Officer's Academic Performance and Their Scores on an Intelligence and Personality Test Battery," Paper presented at the Western Psychological Association, Vancouver, B.C., 1969.

Shaffer, Julie and Rosenfeld, Howard, MAT-GRE Prediction Study-Initial Results, Intra-Departmental Memorandum, Department of Psychology, University of Kansas, 1968, In: Lannholm, Gerald V. "Summaries of GRE Validity Studies 1966-1970," Graduate Record Examination Special Report Number 72-1, 1972, p. 19.

Stricker, George and Haber, J. T.,"The GRE and Undergraduate Grades as Predictors of Success in Graduate School," Journal of Educational Research, 1967, vol. 10. pp. 466-468.

Taylor, H. C. and Russell, T. J., "The Relationship of Validity Coefficients to the Practical Effectiveness of Tests in Selection: Discussion and Tables, Journal of Applied Psychology, 1939, vol. 23, pp. 565-578.

Test Office, Sacramento State College, "An Analysis of Traditional Predictor Variables and Various Criteria of Success in the Master's Degree Programs at Sacramento State College for an Experimental Group who Received Master's Degrees in the Spring 1968, and a Comparable Control Group Who Withdrew From Their Programs," Test Office Report, Sacramento State College, 1969. In: Lannholm, Gerald V. "Summaries of GRE Validity Studies 1966 - 1970, Graduate Record Examinations Special Report No. 72-1, 1972, p. 20

Thorndike, R. L., Personnel Selection, Wiley: New York, 1949.

Tyler, Leona, The Psychology of Human Differences, 3rd Ed. New York, Appleton-Century, Crofts, 1965.

Wagman, Morton, "Clinical and Research Use of SVIB Academic Achievement Scale," Journal of Counseling Psychology, 1971, vol. 18, pp. 337-40.

Williams, John D., Harlow, Steven D. and Gar, Del, "A Longitudinal Study Examining Prediction of Doctoral Success: Grade Point Average as Criterion or Graduation vs. Non-Graduation as Criterion," Journal of Education Research, 1970 vol. 64, pp. 161-164.

Willingham, W. W., "Predicting Success in Graduate Education," Science,25 January 1974, pp. 273-278.

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